

# Sea Ice Imagery Classification with Machine Learning and High- Performance Computing

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Ice and snow at the poles are critical components of the climate system .

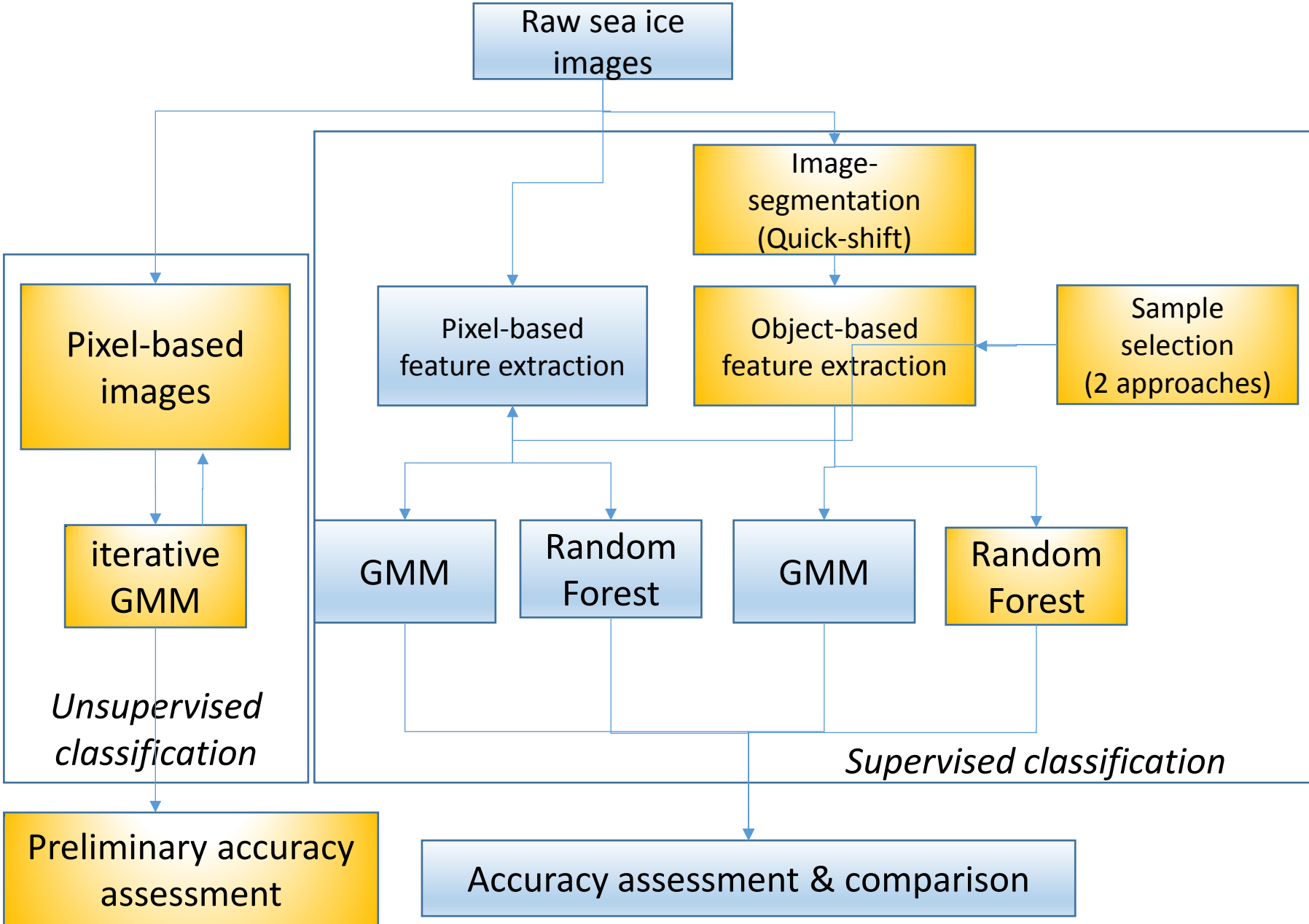
Extent of ice and snow determines how much solar radiation is reflected back to space.

Size and number distribution of melt ponds is needed for models



# Hackathon Goals

- Develop an open-source toolkit for classification of sea ice images
- Support HPC resources through XSEDE
- Support data from multiple sensor platforms (Aerial photography, Quickbird, etc)
- Support multiple segmentation and classification methods
- Community effort
- Extensibility



# jupyter notebooks describing methods

 **jupyter** SealceSegmentation Last Checkpoint: 19 hours ago (autosaved)



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Python 2 

          Markdown  Cell Toolbar: None 

## Sea ice segmentation

IPython Notebook to demonstrate three different segmentation of sea ice images for the XSEDE Polar Hackathon

Contributing authors: Alek Petty, Andrew Barrett, Xin Miao, Phil McDowell, Vivek Balasubramanian

Additional info: Just testing out different scikit-learn (skimage) image segmentation functions. Plan is to then use these objects (rather than pixels) to drive the sea ice classification (add link to notebook)

Segmentation comparison inspired by [http://scikit-image.org/docs/dev/auto\\_examples/plot\\_segmentations.html](http://scikit-image.org/docs/dev/auto_examples/plot_segmentations.html)

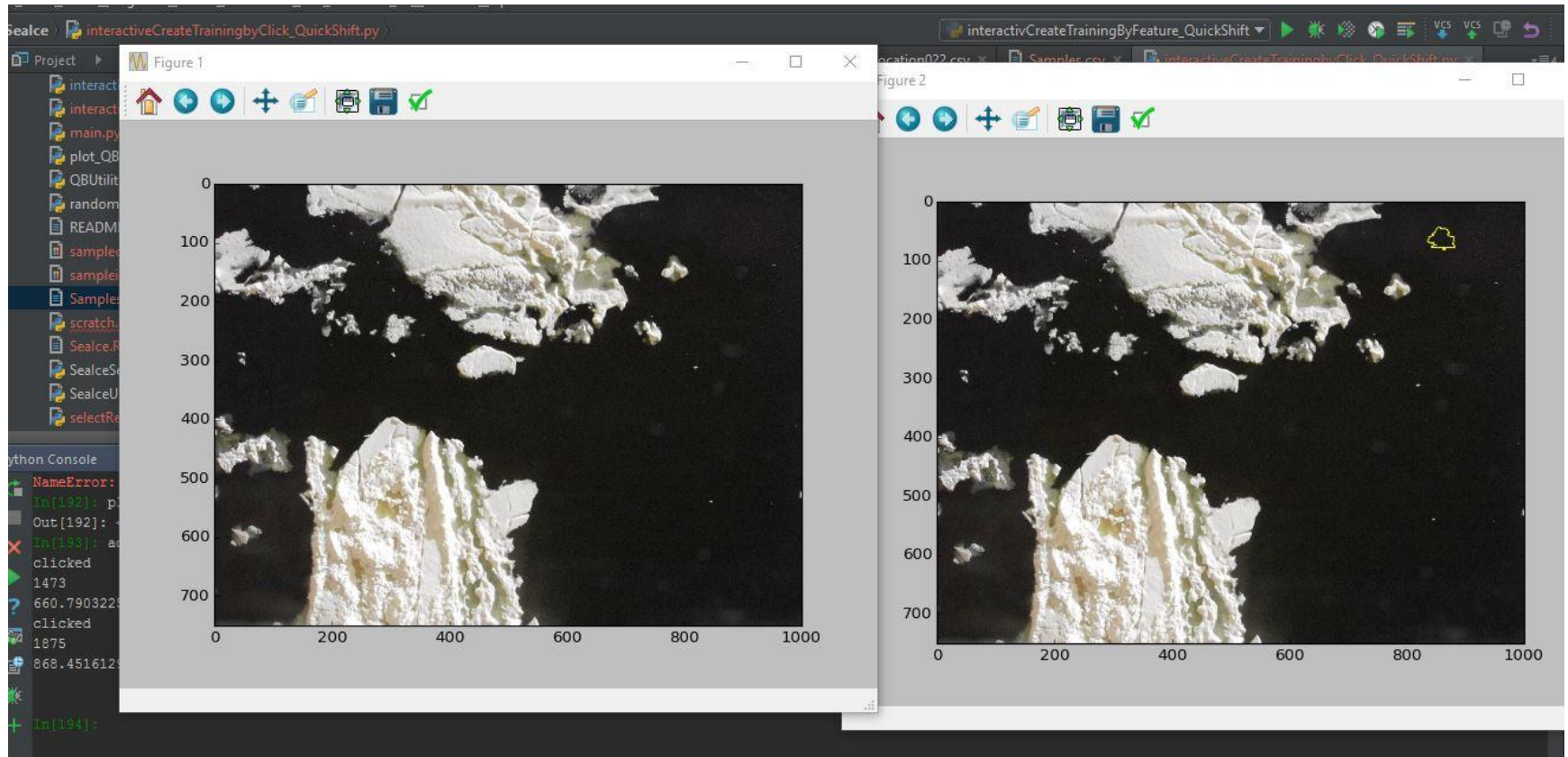
```
In [31]: %matplotlib inline
          #import cv2
          from pylab import *
          from scipy import misc
          from skimage.segmentation import mark_boundaries

          filePath = "../../../DATA/IMAGERY/XIN/072610_00104.jpg"

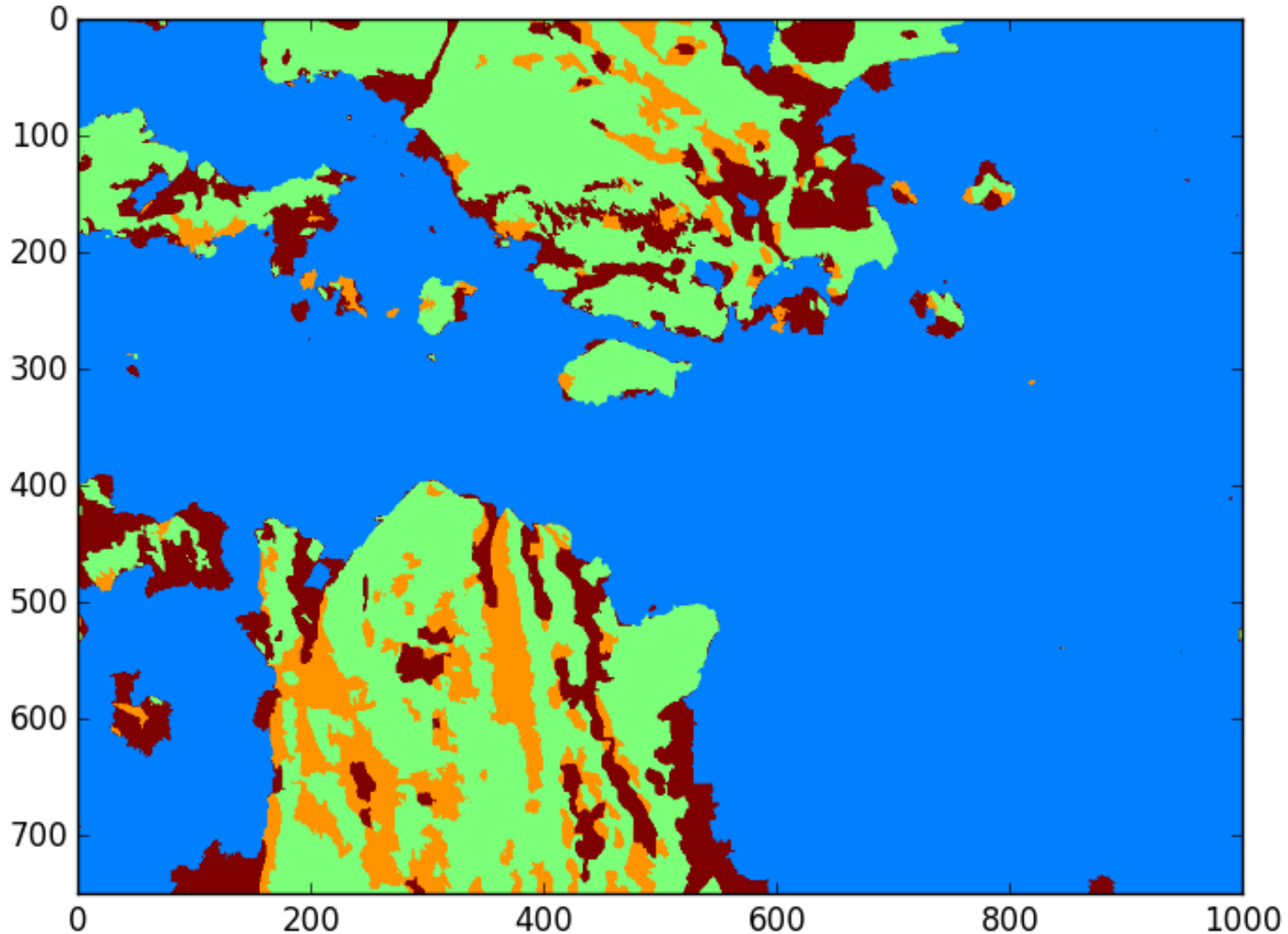
          img = misc.imread(filePath)
          fig1 = figure(figsize=(6, 6))
          xlabel('x')
```



# Interactive Object Selection Tool (or a more acronym-friendly name)

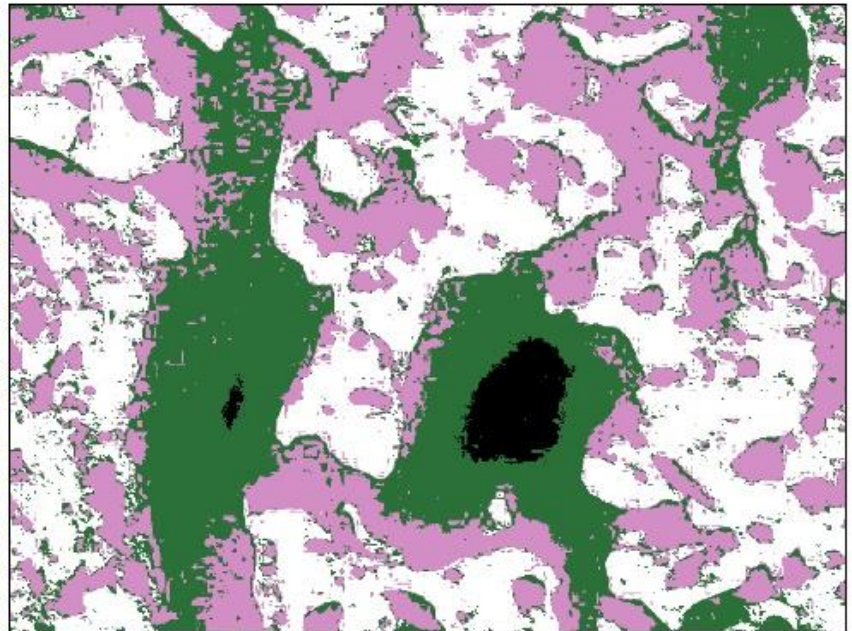
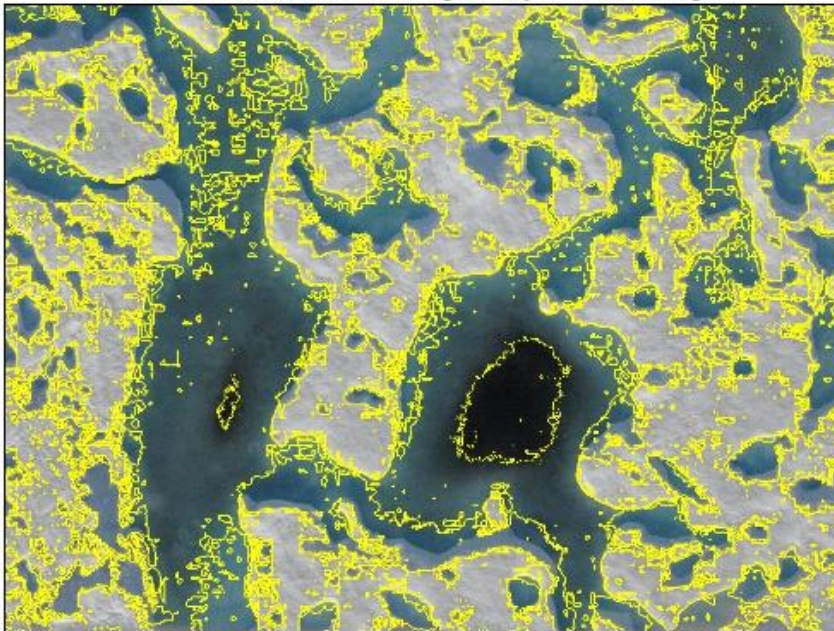


# Random Forest Classification



# Gaussian Mixture Model classification of Aerial Photography

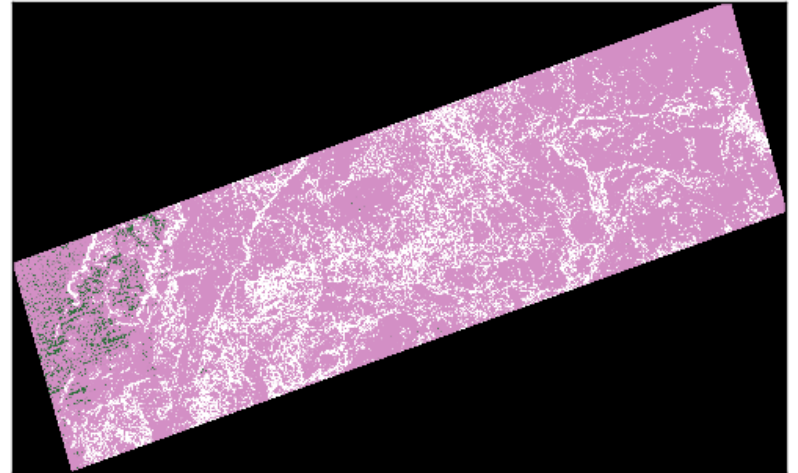
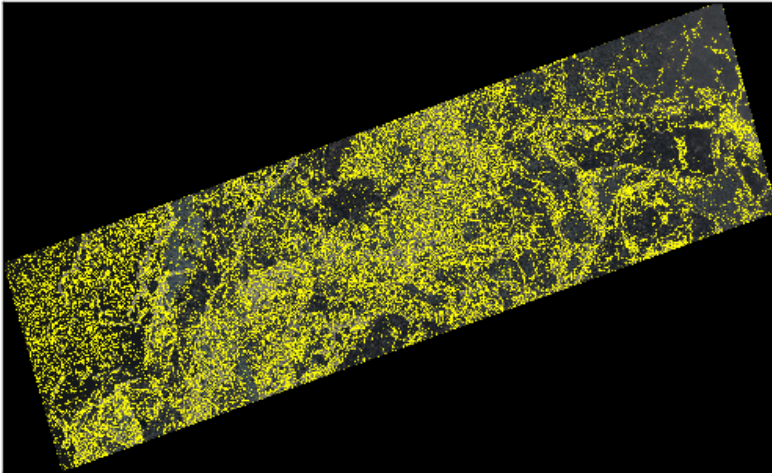
Classification based on training set of just 1 other image





# Gaussian Mixture Model classification of Quickbird GeoTiff on Comet

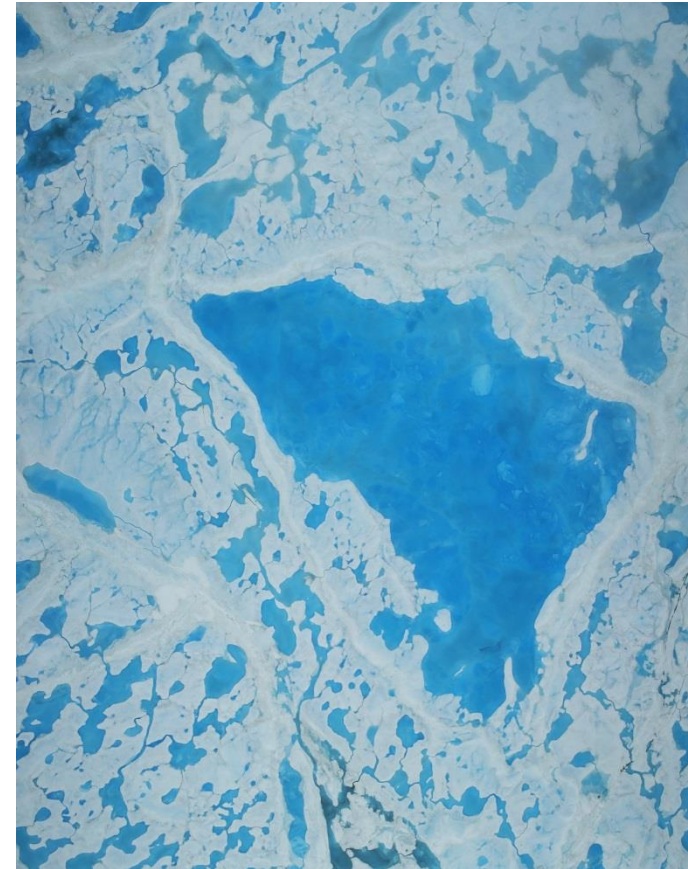
Classification based on training set of multiple images



- Size of classified image: 67 MB
- Number of training images: 3
- Size of training images: 8 MB, 32 MB, 64 MB
- Runtime: 32 minutes
- Number of cores: 1

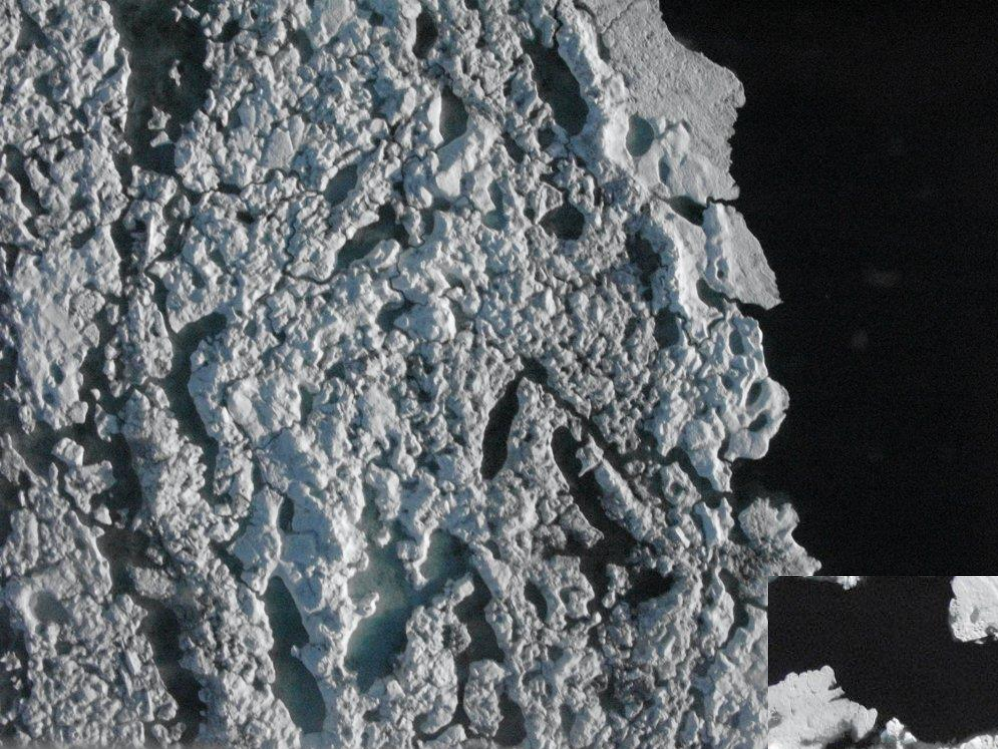
# Outlook and Future Work

- Plan to use toolkit on Comet to classify more images, for example DMS imagery from Operation Icebridge
- Continue to develop toolkit
  - Implement GMM and Quickshift in CUDA to use GPU
  - Distinguish melt ponds from submerged ice
- Submit abstract for poster at fall meeting of American Geophysical Union, San Francisco, December 2016.
- Paper?



Just in! DMS from Operation Icebridge collected 14 July 2016.





Surface types and reflectivity (Albedo) can be estimated from remotely sensed imagery

- Bare Ice
- Snow
- Melt ponds
- Leads
- Open water



# Why is surface type important?

Back Scatter



Forward Scatter

